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Monitoring the Health of Glen Helen Nature Preserve: Spring 2012 Sediment and Water

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Monitoring the Health of Glen Helen Nature Preserve: Spring 2012 Sediment and Water

Conducted by the WSU CHM 735, Special Topics in Analytical Chemistry: Environmental Monitoring of Glen Helen Nature Preserve, Prof. Audrey McGowin

SAMPLING SITES

Sampling events occurred on April 23 and May 14, 2012.

Site	Description	GPS Location
N0	Yellow Springs Creek, north entry into Glen Helen	39° 48' 31" N, 83° 53' 04" W
N1	Yellow Springs Creek, stone crossing downstream of lift station	39° 48' 30" N, 83° 53' 05" W
YS	The Yellow Spring	39° 48' 14" N, 83° 53' 00" W
N3	Yellow Springs Creek, bridge below Trailside Museum	39° 48' 05" N, 83° 53' 02" W
N4	Birch Creek, stone crossing below Trailside Museum	39° 48' 02" N, 83° 52' 59" W
C1	Yellow Springs Creek, upstream from WWTP	39° 47' 32" N, 83° 52' 48" W
WWTP	Yellow Springs Water Reclamation Facility Outfall	39° 47' 27" N, 83° 52' 50" W
C3	Yellow Springs Creek, downstream from WWTP	39° 47' 19" N, 83° 52' 41" W
C4	Covered Bridge	39° 47' 07" N, 83° 52' 41" W

For more information, please contact audrey.mcgowin@wright.edu or dkammler@antiochcollege.org

Onsite Sampling Data

Temperature (°C)
- Weather conditions got warmer as sampling dates proceed onward. Temperature ranging from 9.4 to 20.4 °C.

Dissolved Oxygen (mg/L)
- DO values range from 4 to 14 mg/L with warmer water holding less oxygen.

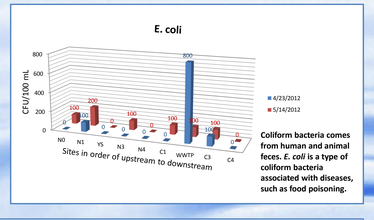
pH
- Values range from 6.9 to 8.48. Western Ohio has limestone in the underline bedrock so pH of natural water is normally basic (above 7). Decaying leaves in the water may lower pH.

Methods
- A Hach kit was used to measure dissolved oxygen levels and a pH meter was used to record temperature and pH.

Left to right: Mark Duffy, Huong Hoang, and Fadwa Constandinidis.

Microbial Data

Left to right: Richard Cooke, Markeata Lee, and Huong Hoang.



Coliform bacteria comes from human and animal feces. *E. coli* is a type of coliform bacteria associated with diseases, such as food poisoning.

Biological Oxygen Demand 7
- BOD_7 is the amount of dissolved oxygen consumed in 7 days by bacteria when they break down waste contained in the water.
- The north sites in general had higher BOD_7 than the central sites, indicating higher levels of waste.

Total Coliform & *E. coli*
- The WWTP disinfects their effluent with chlorine during the months of May 1 to October 31. Total coliform and *E. coli* levels increased as weather conditions got warmer but were significantly reduced at the WWTP site in May 2012. In contrast, microbial levels decreased during Fall 2011 as weather conditions got colder but rose significantly at the WWTP site in November 2011.

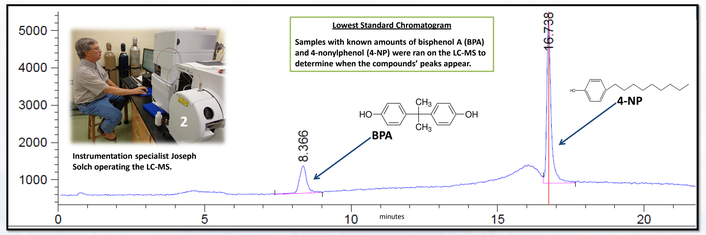
Methods
- Water samples were transferred to petri plates and placed in an incubator at 37 °C for 48 hours. The E. coli and coliform colonies on the plate were afterwards counted.

Polar Organic Chemical Integrative Sampler (POCIS) Data Using Liquid Chromatography-Mass Spectrometry (LC-MS)

Front (left to right): Mark Duffy, Fadwa Constandinidis, and Jessica Davis.

POCIS Sampler

Methods
- BPA and 4-NP are organic contaminants frequently found in WWTP effluents. A POCIS sampler was deployed at the WWTP site for two weeks. Compounds collected by the sampler were extracted (**1**) and analyzed on the LC-MS (**2**) to determine whether BPA and 4-NP were present in the WWTP effluent.

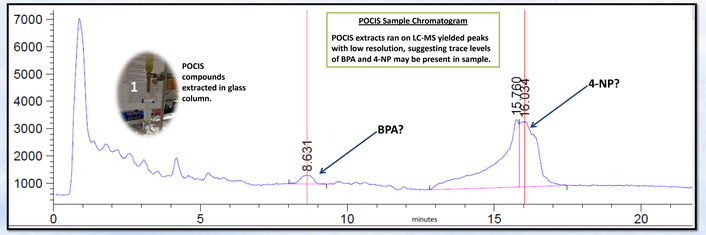


Bisphenol A (BPA)
- A chemical used in many plastics, water bottles, food can liners, etc.
- It is an endocrine disruptor that can act as a hormone in the body.
- Effects are not yet clear.

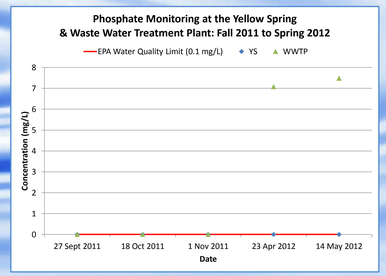
4-nonylphenol (4-NP)
- A persistent product resulting from the degradation process of the detergents and consumer products.
- It is toxic to aquatic life and acts as an estrogen emulator.

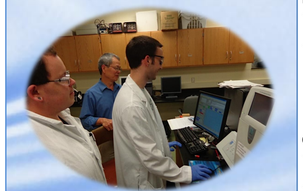
The basic component of the POCIS sampler is an adsorbent solid phase contain within a hydrophilic membrane (**3**).

The sorbent phase sequesters pharmaceuticals and personal care products from surface waters during the time the POCIS is deployed.



Anion Analysis of Water Samples Using Ion Chromatography (IC)





Left to right: Kyle Danielson, Prof. Songlin Cheng, and Mark Duffy operating the IC.

Anions analyzed on the IC include phosphate, nitrate, nitrite, bromide, chloride, fluoride, and sulfate.

Phosphate
- Phosphate was detected for the first time at levels well above the EPA water quality limit during Spring 2012.
- All phosphorus was assumed to be in the form of ortho-phosphate. Based upon a concentration of 7.5 mg/L, the May 2012 calculated phosphorus discharge amount was 2.82 kg/day. This is above the monthly loading limit (2.28) but below the permitted weekly loading limit (3.41) listed in the National Pollutant Discharge Elimination System permit 1PC00013001. The discharge concentration must be reduced to 1.1 kg/day by May 1, 2013.

Other Anions
- Like in Fall 2011, chloride, nitrate, and sulfate were detected at all sites in the Glen, and anion levels were generally highest at the WWTP.
- Nitrite and bromide were also detected for the first time but at very low levels. Nitrite was detected at the N0 site, while bromide levels were detected at N0 on April 23 and at the Yellow Spring on May 14.
- Fluoride was present only at the Yellow Spring, but fluoride is a contaminant of lesser concern that naturally occurs in ground water.

Discussion

- The chemical health of Glen Helen Nature Preserve was assessed through consideration of environmental cofactors and human activities.
- Experimental procedures did not strictly adhere to Good Laboratory Practice (GLP) conditions due to the limitations of an academic setting, but GLP was followed as strictly as possible.
- *E. coli* levels indicate sites across the Glen are suitable for recreational activities, and the WWTP is in compliance with their permit for *E. coli*.
- Further investigation must be conducted to verify the identities of the organic contaminants detected in the WWTP effluent.
- High phosphate levels at WWTP are of concern and warrant further monitoring.
- The presence of metals was detected more frequently in sediment than water.
- Aluminum, arsenic, cadmium, iron, and lead were the only metals in water found at levels above the EPA drinking water limit, which doesn't apply to natural waters but serve as a helpful baseline for water quality assessment.
- Arsenic and cadmium were the only metals in sediment detected above the EPA TEC limit at the Yellow Spring.
- Monitoring of heavy metals in the sediment will be continued at the Yellow Spring.

Fall 2011

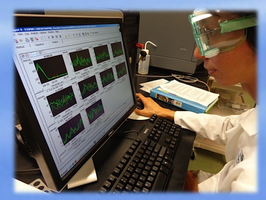
http://core.libraries.wright.edu/handle/2374.WSU/5720

Spring 2012

http://core.libraries.wright.edu/handle/2374.WSU/6129

Metal Analysis of Water & Sediment Samples Using Inductively Coupled Plasma (ICP)

Metals in Water
- Cadmium raised the most concern due to its presence (0.008-0.011 mg/L) above the EPA drinking water limit (0.005 mg/L) across all sampling sites. Although cadmium levels may be overestimated, its noticeable presence warrants further investigation.
- The Yellow Springs is a popular source of drinking water at the Glen, so further investigation should be conducted regarding the status of lead, which was detected for the first time (0.029 mg/L) this Spring and only at this site in May 2012.
- Iron and aluminum are naturally occurring metals in the area and are primarily aesthetic contaminants, so concentrations above the EPA limit (0.300 and 0.02-0.5 mg/L, respectively) raise less alarm.
- Arsenic was only detected at the N1 site (0.075 mg/L), but future studies should continue to monitor arsenic due to its toxicity and the fact it has been detected in past studies (Fall 2010).



Teaching assistant Triet Truong operating the ICP.

Metals analyzed on the ICP include Aluminum, Arsenic, Cadmium, Cobalt, Chromium, Copper, Iron, Nickel, Lead, and Zinc.

Metals in Sediment
- A sediment sample from the C4 site contained levels of chromium, nickel, and copper above the EPA threshold effect concentration (TEC) limits, but these metals were significantly lower in another sample obtained from the same site. Debris from vehicles passing by the covered bridge could be a possible source of contamination. Need further assessment to verify discrepancies.
- Low levels of arsenic and cadmium from the Yellow Spring accumulate over time. Sources are likely natural minerals. However, the Yellow Springs is a popular source of drinking water at the Glen, so further investigation should be conducted regarding the status of cadmium and arsenic at the site for public safety.

* Levels (mg metal/kg dry soil) above the TEC indicate toxicity to aquatic life.

*TEC limits for chromium, nickel, and copper are 43.4, 22.7, and 31.6 mg metal/kg dry soil, respectively.